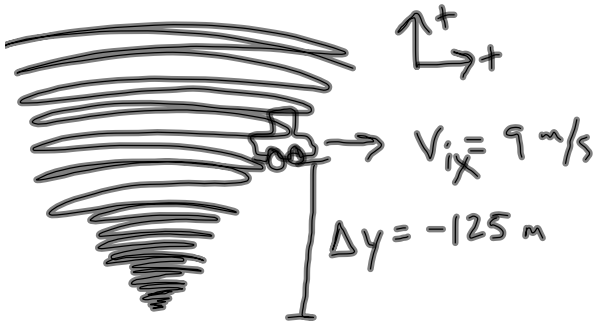
Projectile Motion Practice Problems 2.23.12 Honors Physics

During a thunderstorm, a tornado lifts a car to a height of 125 m above the ground. Increasing in strength, the tornado flings the car horizontally with a speed of 9.0 m/s. How long does the car take to reach the ground? How far horizontally does the car travel before hitting the ground?



$v_{iy} = 0$ m/s

$a_g = -9.8\ m/s^2$

a) $t = ?$

$$\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= \sqrt{\frac{2(-125\ m)}{(-9.8\ m/s^2)}}$$

$$= 5.1\ s$$

b) $\Delta x = ?$

$$\Delta x = v_{ix}t$$

$$= (9\ m/s)(5.1\ s)$$

$$= 45.9\ m/s$$

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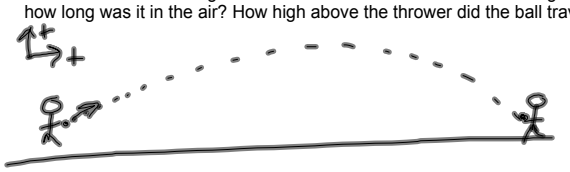
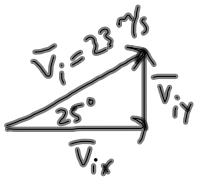
A baseball is thrown at an angle of 25 degrees relative to the ground at a speed of 23.0 m/s. If the ball was caught 42.0 m from the thrower at the same height it was thrown, how long was it in the air? How high above the thrower did the ball travel?





$v_{ix} = v_i \cos(25°)$
$= 20.85$ m/s

$v_{iy} = v_i \sin(25°)$
$= 9.72$ m/s

$\Delta x = 42$ m

$a_g = -9.8$ m/s^2

a) $t = ?$

$$\Delta x = v_{ix} t$$
$$t = \frac{\Delta x}{v_{ix}}$$
$$= 2.01 \text{ s}$$

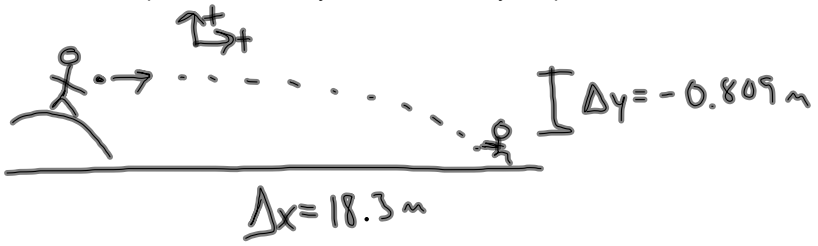
b) $\Delta y = ?$

* we have to take $\frac{1}{2}t$ when finding Δy. This only applies when object lands at same height it started.

new time = 1.005 s

$$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$$
$$= (9.72 \text{ m/s})(1.005 \text{ s}) + \frac{1}{2}(-9.8 \text{ m/s}^2)(1.005 \text{ s})^2$$
$$= 4.82 \text{ m}$$

The fastest recorded pitch in Major League Baseball was thrown by Nolan Ryan in 1974. If this pitch were thrown horizontally, the ball would fall 0.809 m by the time it reached home plate, 18.3 m away. How fast was Ryan's pitch?



$v_{iy} = 0$ m/s $\quad v_{ix} = ?$ $\quad a_g = -9.8$ m/s^2

$\Delta y = -0.809$ m $\quad \Delta x = 18.3$ m $\quad t = ?$

Solve for t

$$\Delta y = \cancel{v_{iy}}^{0} t + \frac{1}{2} a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= 0.406 \text{ s}$$

Solve for v_{ix}

$$\Delta x = v_{ix} t$$

$$v_{ix} = \frac{\Delta x}{t} = 45.04 \text{ m/s}$$

$$\downarrow$$

101 mph

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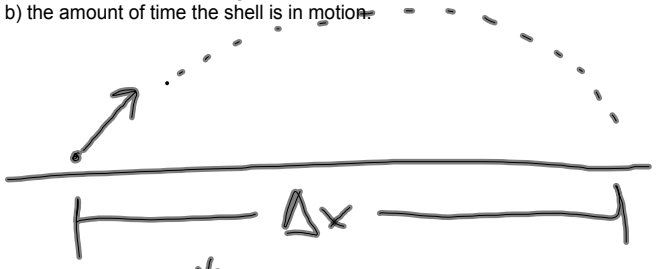
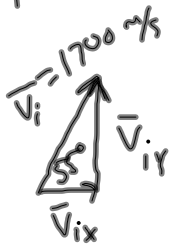
A shell is fired from the ground with an initial speed of 1.70E3 m/s at an initial angle of 55 degrees to the horizontal and returns to the ground. Neglecting air resistance, find
a) the shell's horizontal range.
b) the amount of time the shell is in motion.





$V_{ix} = V_i \cos(55°)$

$= 975 \text{ m/s}$

$V_{iy} = V_i \sin(55°)$

$= 1392 \text{ m/s}$

*assumption to make is that $V_{fy} = -V_{iy}$. we can make this because shell lands at the same height it starts

b) $t = ?$

$$V_{fy} = V_{iy} + a_g t$$

$$t = \frac{V_{fy} - V_{iy}}{a_g}$$

$$= \frac{-1392 \text{ m/s} - 1392 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

$$= 284 \text{ s}$$

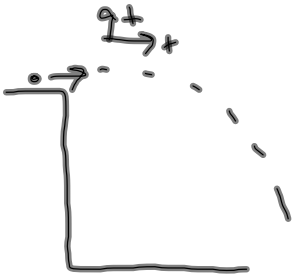
a) $\Delta x = ?$

$$\Delta x = V_{ix} t$$

$$= 277113 \text{ m}$$

Projectile Motion Practice Problems 2.23.12 Honors Physics

A person standing at the edge of a seaside cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface.
a) How long does it take for the stone to fall to the water?
b) With what speed does it strike the water?



$v_{iy} = 0\ m/s \quad v_{ix} = 18\ m/s$

$v_{fx} = 18\ m/s$

$v_{fy} = ?$

$t = ? \quad a_g = -9.8\ m/s^2$

$\Delta y = -52\ m$

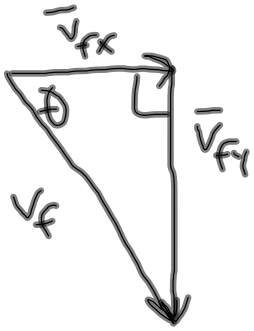
a) $t = ?$

$$\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= 3.26\ s$$

b) $v_f = ?$



$$v_i = \sqrt{v_{fx}^2 + v_{fy}^2}$$

$$= 36.7\ m/s$$

$$v_{fy} = v_{iy} + a_g t$$

$$= -31.95\ m/s$$